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(71)Applicant : SEIKO EPSON CORP
(72)Inventor : YOKOYAMA OSAMU

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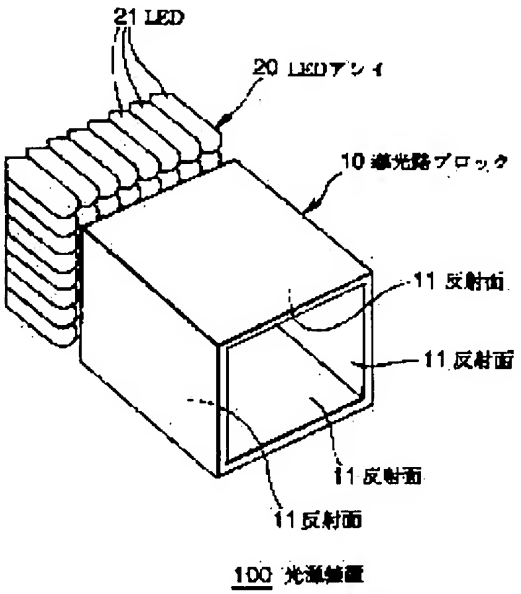
(54) LIGHT SOURCE DEVICE, OPTICAL DEVICE AND LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To miniaturize a light source device and to display a projected picture having no irregularity in the intensity of light by providing a point light source array where plural point light sources are arranged in a planar state on either end face side of a light guide means and which is a separate body from the light guide means.

SOLUTION: A light guide block 10 is constituted by sticking four mirrors whose size is the same as one wall surface so that their mirror surfaces may be opposed. An LED array 20 is constituted by two-dimensionally integrating plural light emitting diodes(LEDs) 21 being the point light sources in the planar state, is the separate body from the block 10, and is desirably arranged so that an air layer may intervene between the block 10 and the LED array 20. The light from the LED array 20 is uniformly mixed while it is reflected by the inner wall surfaces(reflection surfaces 11) of the block 10 inside the block 10, and emitted from the end face side opposed to a surface provided with the LED array 20. Since the point light source such as the LED array 20 is small in size and light in weight and the power consumption thereof is low, the device can be driven by a portable power source such as a battery. Furthermore, the device is easily and inexpensively produced.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] A light guide means to have the light guide function which draws and carries out outgoing radiation of the light which was equipped with the end face which counters mutually and carried out incidence from one end face to an other-end side, and said light guide means by which two or more point light sources have been arranged in the shape of a field at one end-face side of this light guide means are light equipment which has the point light source array of another object.
[Claim 2] Light equipment which comes respectively to have the point light source array by which two or more point light sources have been arranged in the shape of a field, and the light guide means which is made to carry out incidence of the light from this point light source array from an end side at least, is made to mix, and draws and carries out outgoing radiation to other end-faces side with an exception object.
[Claim 3] The appearance of the end face in which the appearance and light of the end face in which light carries out incidence from said point light source array side carry out outgoing radiation in said light guide means is equal light equipment according to claim 1 or 2 substantially.

[Claim 4] Light equipment according to claim 1 or 2 said whose point light source is the light emitting device of monochrome luminescence.
[Claim 5] Said point light source array is light equipment according to claim 1 or 2 which combines the light emitting device of a different color.
[Claim 6] Said light guide means is light equipment of claim 1 thru/or the any 1 term publication of five it is unstated from the solid of a transparent material, or a transparent material in the air.
[Claim 7] Light equipment according to claim 1 or 2 with which an air space comes to intervene between said point light source arrays and incidence end faces of the light of said light guide means.
[Claim 8] Light equipment according to claim 6 other than the end face in which the end face in which light carries out incidence from said point light source array side, and light carry out outgoing radiation in the transparent material of said hollow whose fields by the side of the interior of a light guide means of an end side are metallic reflection sides at least.
[Claim 9] Light equipment according to claim 6 whose field by the side of the interior of a light guide means of an end side is a total reflection side over light other than the end face in which the end face in which light carries out incidence from said point light source array side, and light carry out outgoing radiation in the transparent material of said solid drawn in a metallic reflection side or this light guide means at least.
[Claim 10] Light equipment according to claim 6 with which said reflector consists of two or more flat reflectors, and said transparent material has a multiple column configuration.
[Claim 11] Light equipment according to claim 6 with which it comes to consist of said reflector curved surfaces.
[-- claim time -- 12] The appearance of the optical exposure side of the illuminated body with which the light by which this outgoing radiation was carried out to the appearance of the end face in which the light in said light guide means carries out outgoing radiation is irradiated is the

same light equipment according to claim 1 or 2 substantially.
[Claim 13] Light equipment of claim 1 thru/or the any 1 term publication of 12 which is constituted and becomes so that the luminous intensity to which spacing between the adjoining point light sources [in / for the distance from the incidence side of the light in a light guide means to an outgoing radiation side / L and a point light source array] is emitted from P and the point light source may set to theta the include angle from the optical axis of the location set to one half of the reinforcement on the optical axis of the light concerned and may fill the relation of L>=P/(tantheta).
[Claim 14] Said point light source is light equipment of 13 claim 1 which is light emitting diode thru/or given in any 1 term.
[Claim 15] claim 1 thru/or either of 14 -- the optical equipment which has the light equipment of a publication, and the member which the light of said light guide means counters the end face which carries out outgoing radiation, is arranged, and modulates the light from the light guide means concerned.
[-- claim time -- 16] It is [the appearance area of the optical exposure side of a member where the appearance area of the end face in which the light in said light guide means carries out outgoing radiation modulates the light from said light guide means, and] the same optical equipment according to claim 15 substantially.
[Claim 17] The liquid crystal display which has the liquid crystal display component which modulates the light by which the light equipment of 14 claim 1 thru/or given in any 1 term and the light of said light guide means countered the end-face side by which outgoing radiation is carried out, and have been arranged, and outgoing radiation was carried out from said light guide means.
[Claim 18] Furthermore, the liquid crystal display according to claim 17 which has the magnifying lens arranged on the optical path of the outgoing radiation light in which light modulation was carried out by said liquid crystal display component.
[Claim 19] Furthermore, the liquid crystal display according to claim 18 which has the screen which the image of said liquid crystal display component consisted of possible [projection] with said magnifying lens.
[Claim 20] The appearance area of the end face in which the light in said light guide means carries out outgoing radiation is [the appearance area of the screen of said liquid crystal display component, and] the same liquid crystal display according to claim 17 substantially.
[Claim 21] Light equipment equipped with the light guide line block as a light guide means formed in the shape of hollow so that it might have the wall equipped with light reflex nature and a light guide line might be constituted, and the point light source array which counters one end face of this light guide line block and by which two or more point light sources have been arranged in the shape of a field possible [injection] in light in said light guide line.
[Claim 22] Said light guide line block is light equipment according to claim 21 which has the multiple column configuration where said wall consisted of two or more flat reflectors.
[Claim 23] Said light guide line block is light equipment according to claim 21 which has the shape of a cylindrical shape by which said wall was constituted from a curved surface.
[Claim 24] Said light guide line block is light equipment according to claim 21 which has the square pole configuration which consists of four side faces corresponding to the end face of the side by which said point light source array has been arranged, the end face in which this point light source array was prepared and the end face which carries out outgoing radiation of the light which counters, and the wall equipped with light reflex nature.
[Claim 25] Said point light source is light equipment of 24 claim 21 which is light emitting diode thru/or given in any 1 term.
[Claim 26] Optical equipment which has the member which counters the end face in which the light equipment of a publication and the light of said light guide line block carry out outgoing radiation to claim 21 thru/or any 1 term of 25, is arranged, and modulates the light from this light guide line block.
[Claim 27] Appearance area of the optical exposure side of ** material where the appearance area of the end face in which the light in said light guide line block carries out outgoing radiation

modulates the light from this light guide line block, and optical equipment according to claim 26 it is [equipment] the same magnitude substantially.
[Claim 28] The liquid crystal display which is a liquid crystal display equipped with the light equipment of 25 claim 21 thru/or given in any 1 term, counters the end face in which the light of said light guide line block carries out outgoing radiation, is arranged, is equipped with the liquid crystal display component which consisted of this light guide line block possible [a modulation of the light by which outgoing radiation was carried out], and consists of irradiation appearance sides of this liquid crystal display component possible [accepting reality of an image].
[Claim 29] A liquid crystal display equipped with the magnifying lens which was the liquid crystal display which equipped claim 21 thru/or any 1 term of 25 with the light equipment of a publication, countered the other-end side of said light guide line block, has been arranged, and has been arranged on the optical path of the outgoing radiation light in which light modulation was carried out by the liquid crystal display component which consisted of this light guide line block possible [a modulation of the light by which outgoing radiation was carried out], and this liquid crystal display component.
[Claim 30] The liquid crystal display according to claim 29 further equipped with the screen which the image of said liquid crystal display component consisted of possible [projection] with said magnifying lens.
[Claim 31] It is the liquid crystal display which equipped any 1 term of claim 1 14 and 21 thru/or 25 with two or more light equipment of a publication. Said light equipment The liquid crystal display component which is constituted possible [injection of the light of the wavelength field of each primary color], and was constituted possible [a modulation of the light which countered the end face in which the light of said light guide means carries out outgoing radiation to this light equipment, has been arranged and was injected from said light guide line], since -- the liquid crystal display which the becoming specific color modulation unit is made to correspond to primary color, has, and is equipped with the color composition means constituted possible [composition of the light injected from each specific color modulation unit], and the projection lens arranged on the optical path of the injection light compounded by this color composition means.
[Claim 32] It is the liquid crystal display equipped with two or more light equipment of 25 claim 1 14 and 21 thru/or given in any 1 term. The liquid crystal display component which modulates the light which this light equipment countered the end face in which carries out outgoing radiation of the white light, and the light of said light guide means carries out outgoing radiation to this light equipment, has been arranged, and was injected from said light guide line, the filter constituted possible [transparency of the light of the wavelength field of each primary color] -- since -- the becoming specific color modulation unit being made to correspond to primary color, and it having, and with the color composition means constituted possible [composition of the light injected from each specific color modulation unit] A liquid crystal display equipped with the projection lens arranged on the optical path of the injection light compounded by this color composition means.
[Claim 33] The liquid crystal display according to claim 31 or 32 said whose color composition means is a dichroic prism.
[Claim 34] The point light source array by which two or more light emitting devices which emit light in three-primary-colors light, respectively have been arranged in the shape of a field, and this point light source array are light equipment which comes to have the transparent material which is another object, is made to carry out incidence of the light from this point light source array from an end side, and is led to other end-faces side.
[Claim 35] Light equipment according to claim 34 with which the light emitting device which emits light in each color is prepared in coincidence or the circuit which carries out sequential lighting.
[Claim 36] Light equipment with which it comes to arrange the fluorescence film which is equipped with the point light source array by which two or more light emitting devices which emit light in the homogeneous light have been arranged in the shape of a field, and the transparent material which is made to carry out incidence of the light from this point light source array from

an end side, and is led to other end-faces side, counters the plane of incidence or the outgoing radiation side of this transparent material, and changes said homogeneous light into the white light.
[Claim 37] Claim 34 by which the air space is arranged between said point light source arrays and said light guide means thru/or light equipment of 36 given in any 1 term.
[Claim 38] Light equipment given in claims 34 other than the end face in which the end face in which said transparent material is a thing in the air, and light carries out incidence from said point light source array side, and light carry out outgoing radiation whose fields inside said transparent material of an end side are metallic reflection sides at least thru/or any 1 term of 36.
[Claim 39] Light equipment according to claim 34 to 36 said whose transparent material is the thing of a solid and whose field inside said transparent material of an end side is a total reflection side to light other than the end face in which the end face in which light carries out incidence from said point light source array side, and light carry out outgoing radiation drawn in a metallic reflection side or the transparent material concerned at least.
[Claim 40] Spacing between the adjoining point light sources [in / for the distance from the incidence side of the light in a light guide means to an outgoing radiation side / L and a point light source array] P, Light equipment of claim 34 thru/or the any 1 term publication of 39 which is constituted and becomes so that the luminous intensity to which the luminous intensity emitted from each LED is emitted from the point light source may set to theta the include angle from the optical axis of the location set to one half of the reinforcement on the optical axis of the light concerned and may fill the relation of L>=P/(tantheta).
[Claim 41] Claim 34 said whose light emitting device is light emitting diode thru/or light equipment of 40 given in any 1 term.
[Claim 42] Optical equipment which has the light equipment of 40 claim 34 thru/or given in any 1 term, and the member which the light of said light guide means counters the end face which carries out outgoing radiation, is arranged, and modulates the light from said light guide means.
[Claim 43] Appearance area of the optical exposure side of a member where the appearance area of the end face in which the light in said light guide means carries out outgoing radiation modulates the light from said light guide means, and optical equipment according to claim 40 it is [equipment] the same magnitude substantially.
[Claim 44] A liquid crystal display equipped with the light equipment of 40 claim 33 thru/or given in any 1 term, and the liquid crystal display component which counters the outgoing radiation end face of the light of said light guide means, is arranged, and modulates the light from a transparent material.
[Claim 45] The liquid crystal display according to claim 44 which has the projector lens arranged to said liquid crystal display component in a transparent material and the opposite side.
[Claim 46] The point light source array by which two or more light emitting devices which emit light in three-primary-colors light, respectively have been arranged in the shape of a field, Light equipment equipped with the transparent material which is made to carry out incidence of the light from this point light source array from an end side, and is led to other end-faces side, It is the liquid crystal display which countered the outgoing radiation end face of the light of said transparent material, has been arranged, and was equipped with the liquid crystal display component. The liquid crystal display characterized by for said liquid crystal display component modulating the light of each color based on the picture signal separated for every color synchronizing with sequential lighting of the light emitting device of each of said color being carried out, and forming an image.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a projection mold liquid crystal display, i.e., the light equipment used for a projector. Especially this invention relates to the small light equipment suitable for a small projector.
[0002]
[Description of the Prior Art] Conventionally, as a projector which displays by carrying out expansion projection of the image of a liquid crystal display component, the liquid crystal display component of one sheet was illuminated with the metal halide lamp from the tooth back, and there were some which were constituted so that expansion projection of the image displayed on a liquid crystal display component might be carried out with a projection lens.
[0003] For example, use a metal halide lamp and a halogen lamp for JP,62-237485,A, JP,3-75737,A, and JP,8-111107,A as the light source, they are made to spread the light injected from these light sources with light guide structure in the air, and the configuration of invention of leading to a liquid crystal display component is indicated.
[0004]
[Problem(s) to be Solved by the Invention] However, with the above-mentioned conventional technique, since the lamp is used as the light source, there is a limitation in making magnitude of the light source itself small. Therefore, it was difficult to miniaturize the whole projector. In recent years, personal digital assistant equipment appears on the market mostly, and there is not necessarily no need of projecting an image in big size which exceeds 60 inches also as a projector. For example, also when the size of the image projected may be as small as 10 inches or about 20 inches, it thinks. In the size of such an image projected, since light emitting devices (a light emitting diode, semiconductor laser, etc.) etc. become usable as the light source, it is expected that the size of a projector can be miniaturized extremely.
[0005] However, since small luminescence equipments, such as a light emitting device, are the point light sources generally, they are difficult to illuminate to homogeneity for the liquid crystal display component which has a fixed area. Even if it is going to put two or more light emitting diodes in order and is going to illuminate a large area, since it is only the set of the point light source, unevenness will arise in luminous intensity in a 2-dimensional flat surface after all.
[0006] Moreover, the technique of BUROJIEKUTA which makes the light source two-dimensional array of a light emitting diode is indicated by JP,10-123512,A. In order to lead effectively the synchrotron orbital radiation from the light emitting diode which is the point light source to a liquid crystal display component, the light from light emitting diode is changed into flat-surface light by the micro-lens array which is the array of the lens element formed corresponding to each light emitting diode.
[0007] However, in a micro-lens array, a lens operation of the boundary of the lens element which adjoins each other according to the error on manufacture etc. becomes weak, and there is a trouble that equalization of the illumination light is difficult.
[0008] Moreover, although the configuration which 90 degrees of opticals axis are made crooked, and draws light like JP,9-73807,A exists, the technique of making the optical axis of the point

light source going straight on, and obtaining flat-surface light is not established.
[0009] This invention was made in view of such a situation, and aims at offering the light source structure suitable for the miniaturization by which two or more point light sources have been arranged in the shape of a field. Other purposes of this invention are offering the light source which can display the projection image which is small and moreover does not have unevenness in luminous intensity, and the projection mold liquid crystal display further equipped with this by having the structure where a uniform light can be injected, using point light source lighting, such as light emitting diode, two or more.
[0010]
[Means for Solving the Problem] A light guide means for this invention to be equipped with the end face which counters mutually, to draw the light which carried out incidence from one end face to an other-end side, and to have the light guide function which carries out outgoing radiation, and said light guide means by which two or more point light sources have been arranged in the shape of a field at one end-face side of a light guide means are light equipment which has the point light source array of another object.
[0011] Moreover, this inventions are the point light source array by which two or more point light sources have been arranged in the shape of a field, the light guide means which is made to carry out incidence of the light from this point light source array from an end side at least, and homogeneity is made to mix, and draws and carries out outgoing radiation to other end-faces side, and light equipment which it comes to have with an exception object respectively.
[0012] Since this invention person miniaturized the light source, when the relation of the point light source array and light guide means which have been arranged in the shape of a field was considered wholeheartedly, it found out making the outgoing radiation side of the light which carried out incidence to plane of incidence and a light guide means become linearly or in serial, and that said purpose could be attained more for the incident light from the point light source to be diffused in homogeneity in a transparent material to the light guide means against the point light source.
[0013] This invention is made by this knowledge and has the following description.
[0014] In this invention, it is characterized by said point light source being the light emitting device of monochrome luminescence. A light emitting device can apply the point light sources, such as light emitting diode (it is called Following LED) and semiconductor laser (LD), and is not limited to the luminescent color. That is, monochrome (for example, light emitting diode which emits light in whites LED and B (blue)) may be used.
[0015] When using monochrome, such as B (blue), it is desirable to arrange the wavelength sensing element changed into the white light on an optical path.
[0016] In this invention, it is the light emitting device of the color from which said point light source differs, and said point light source array is characterized by combining this light emitting device.
[0017] As well as the three primary colors of RGB, colors other than three primary colors (for example, a sour orange, yellowish green, etc.) may be used for the combination of a light emitting device, and they may be two colors or the combination of four or more colors.
[0018] In this invention, it is characterized by said light guide means consisting of a transparent material of the hollow or solid which is a transparent material. As the 1st mode of a transparent material, it may be a light guide line block in the air, and may be a polygon configuration, or you may be a cylindrical shape-like. Moreover, what equips the hollow light guide line block side face (an internal surface and inner skin) with the metallic reflection reflector is included.
[0019] Furthermore, as the 2nd mode of a transparent material, it replaces with a hollow object and there is a light guide line block of a solid object. What equips this solid light guide line block side face with the total reflection side or the metallic reflection side is included. Moreover, it is good also as a configuration like the so-called SELFOC lens which bundled two or more optical fibers which consisted of a clad and a core in the transparent material.
[0020] Another modes of this invention are said light equipment and optical equipment which has the member which countered the end face in which the light of said light guide means carries out outgoing radiation, and which is arranged and modulates the light from said light guide means.

Other modes of this invention are liquid crystal displays characterized by this member being a liquid crystal display component. The embodiment of this liquid crystal display has the magnifying lens arranged on the optical path of the outgoing radiation light in which light modulation was carried out by said liquid crystal display component. Furthermore, it is possible to have the screen which the image of said liquid crystal display component consisted of possible [projection] with said magnifying lens.
[0021] By irradiating the light which carries out outgoing radiation from the end face of the light equipment of said configuration at a liquid crystal display component, it is possible to face squarely, ****** or ****** the image displayed on the liquid crystal display component.
[0022] The description of this invention makes the light irradiated from light equipment go straight on preferably, without bending the optical axis, is to have arranged a light guide means to make the inside of an area (field) required for image display between them irradiate homogeneity, and becomes possible [preventing exposure light leakage **** to the outside of an irradiated field (the case of a liquid crystal display image display field), and irradiating exposure light effective in an irradiated field].
[0023] This invention is light equipment characterized by having the light guide line block formed in the shape of hollow so that it might have the wall equipped with light reflex nature and a light guide line might be constituted, and the point light source array which counters one end face of a light guide line block, and by which the point light source has been arranged possible [injection of light] in the light guide line.
[0024] According to this configuration, the light injected from the point light source in the part near the center of a point light source array is injected from the other-end side of a light guide line, without being reflected with the wall of a light guide block. It is reflected with the wall of a light guide block, and the light injected from the point light source which is in the part near the circumference of a point light source array on the other hand is injected from an other-end side. The light injected in a path which is different from such each point light source is mixed by homogeneity in a light guide line. Adjustment of the optical-axis lay length of this light guide line equalizes luminous intensity in respect of injection of the light of a light guide line.
[0025] Here, for example, the above-mentioned point light source is light emitting diode. Moreover, the above-mentioned light guide line block has the multiple column configurations (square pole etc.) where the wall consisted of two or more flat reflectors, for example. Moreover, for example, the above-mentioned light guide line block has the shape of a cylindrical shape by which the wall was constituted from a curved surface of the shape of the shape of a cylindrical shape, or an ellipse.
[0026] In addition, in this invention, the end face of a hollow-like light guide block is a field equivalent to the end face of this solid block, when the block concerned is assumed to be a solid.

[0027] This invention is a liquid crystal display characterized by being the liquid crystal display equipped with the above-mentioned light equipment, countering the other-end side of a light guide line block, being arranged, having the liquid crystal display component constituted possible [a modulation of the light injected from the light guide line], and consisting of irradiation appearance sides of a liquid crystal display component possible [accepting reality of an image]. For example, it is a configuration applicable to the liquid crystal display used for pocket mold information machines and equipment.
[0028] This invention is a liquid crystal display characterized by having the magnifying lens which was the liquid crystal display equipped with the above-mentioned light equipment of this invention, countered the other-end side of a light guide line block, has been arranged, and has been arranged on the optical path of the injection light in which light modulation was carried out by the liquid crystal display component constituted possible [a modulation of the light injected from the light guide line], and the liquid crystal display component. For example, it is the configuration of being used for the head mount display which can check the image of a liquid crystal display component, by looking into a direct lens.
[0029] Moreover, this invention may be further equipped with the screen constituted possible [projection of the image of said liquid crystal display component] by the magnifying lens. It is a

configuration applicable to a projector etc.
[0030] Moreover, the light equipment which this invention is the liquid crystal display equipped with the above-mentioned light equipment of this invention, and was constituted possible [injection of the light of the wavelength field of each primary color], The liquid crystal display component constituted possible [a modulation of the light which countered the other-end side of a light guide means, has been arranged, and was injected from the light guide line], since -- the becoming specific color modulation unit being made to correspond to primary color, and it having, and with color composition means, such as a dichroic prism constituted possible [composition of the light injected from each specific color modulation unit] It is the liquid crystal display characterized by having the projection lens arranged on the optical path of this injection light by which synthetic means composition was carried out.
[0031] Moreover, the light equipment which this invention is the liquid crystal display equipped with the above-mentioned light equipment of this invention, and was constituted possible [injection of the white light], The liquid crystal display component constituted possible [a modulation of the light which countered the other-end side of a light guide means, has been arranged, and was injected from the light guide line], the filter constituted possible [transparency of the light of the wavelength field of each primary color] -- since -- the becoming specific color modulation unit being made to correspond to primary color, and it having, and with the dichroic prism constituted possible [composition of the light injected from each specific color modulation unit] It is the liquid crystal display characterized by having the projection lens arranged on the optical path of the injection light compounded with the dichroic prism.
[0032] This invention is light equipment which comes to have the surface light source array by which two or more light emitting devices which emit light in three-primary-colors light, respectively have been arranged in the shape of a field, and the transparent material which consists of a transparent material which leads the incident light from this surface light source array to an outgoing radiation light side.
[0033] This invention is light equipment with which it comes to arrange the fluorescence film which is equipped with the transparent material which two or more light emitting devices which emit light in the homogeneous light become from the transparent material which leads the incident light from the surface light source array arranged in the shape of a field, and this surface light source array to an outgoing radiation light side, counters the plane of incidence or the outgoing radiation side of this transparent material, and changes said homogeneous light into the white light.
[0034] Light equipment is characterized by preparing the light emitting device which emits light in each color in coincidence or the circuit which carries out sequential lighting. Moreover, it is characterized by a light emitting device being light emitting diode.
[0035] This invention is a liquid crystal display equipped with the projection lens with which said transparent material has been arranged in the opposite side to the above-mentioned light equipment, the liquid crystal display component which countered the exit light surface of said transparent material, and has been arranged, and this liquid crystal display component. Other gestalten of the liquid crystal display of this invention form an image one by one based on the picture signal separated for every color synchronizing with sequential lighting of said light emitting diode being carried out in a liquid crystal display component. Here, the white light is desirable as said light emitting diode. It is possible to carry out color mixture of each LED colored in whites LED and RGB as an embodiment which generates the white light. Moreover, what is necessary is to counter the plane of incidence or the outgoing radiation side of said transparent material, and just to arrange the fluorescence film which changes into the white light the light which emits light in monochrome with said light emitting diode, when monochromatic (for example, blue) light emitting diode is applied.
[0036] Moreover, said light emitting diode consists of two or more colors based on three primary colors, it is light equipment characterized by coincidence or carrying out sequential lighting, and the white light is acquired, respectively. In sequential lighting, the after-image of human being's eyes is used.

[0037] Furthermore, said light emitting diode consists of two or more colors based on three primary colors, and since other gestalten of the liquid crystal display of this invention are characterized by what an image is formed for one by one based on the picture signal with which said liquid crystal display component was separated for every color synchronizing with sequential lighting of said light emitting diode and can display the image for every color, they can be made into high resolution while sequential lighting is carried out. Also in this case, a color picture can be obtained according to an after-image.
[0038] In this invention, a light guide means is a functional implementation means to realize the function which carries out the light guide of the light from the light source. One mode of this light guide means is the transparent material as a member which realizes a light guide function, and one mode of this transparent material is a light guide line block. Hollow or a solid member is included by the transparent material. Like previous statement, preferably, when a transparent material is hollow, the metallic reflection film which is the means which has the property which carries out total reflection of the light in the inside is formed.
[0039] This transparent material is equipped with a configuration and a dimension which are mixed by homogeneity in light. Moreover, also about the configuration of a point light source array, the description of point light source arrays, such as an array pitch of the point light source, is adjusted so that it may close, if [in homogeneity mixing of light] in a transparent material.
[0040]
[Embodiment of the Invention] The gestalt of suitable operation of following this invention is explained with reference to a drawing.
(Operation gestalt 1) The operation gestalt 1 of this invention is related with light equipment. The perspective view of the light equipment 100 in this operation gestalt is shown in drawing 1 . The sectional view at the time of cutting the light equipment 100 concerned in accordance with an optical axis to drawing 2 is shown. This light equipment 100 is equipped with the light guide line block 10 and the LED (light emitting diode) array 20.
[0041] The light guide line block 10 is equipped with the prism configuration which has the hollow structure which consisted of wall surfaces of plurality (fourth page). The wall consists of reflectors 11 with light reflex nature. Four sheets are stuck and the light guide line block 10 is constituted so that a mirror plane may counter the mirror of the magnitude of for example, one wall surface. However, to a resin plate etc., four things which vapor-deposited metal thin films, such as aluminum, or stuck the reflexibility film with adhesives are stuck, and may be constituted. carry out for adopting what kind of configuration -- in order to suppress loss of light, the mirror plane where light is smooth to extent in which total reflection is possible is made to the wall of the light guide line block 10.
[0042] LED array 20 accumulates the light emitting diode (LED) 21 which is the point light source on the shape of two or more pages, for example, a secondary former target, is constituted, and a light guide line block is another object, and it is preferably arranged through the air space to the block concerned. Patterning of each LED21 is carried out so that parallel connection of the lead wire of the positive/negative of each LED may be carried out, and it is soldered and fixed to ****** in which it was made to correspond to arrangement of LED and the insertion hole was formed. LED array 20 is equipped with the luminescence side of an area almost equal to the cross section of the light guide line block 10 arranged so that the injection direction of the light of each LED21 might turn to the same direction mostly. The luminescence side of this LED array 20 is arranged in one end face of the light guide line block 10, and the location which counters. It is desirable to arrange the light-emitting part of LED possible [receipt] inside the light guide line block 10 desirably, when abolishing the leakage of light. And current control of each LED20 is carried out so that the optimal about forward current constituted by coincidence possible [luminescence] according to the power source of the exterior which is not illustrated, for example, 20mA, may flow, for example to each LED21. The luminescent color of LED has it, when a white thing carries out especially color display.
[desirable]
[0043] Moreover, Luminescence LED can be arranged for red and the green and blue

homogeneous light in three primary colors by the predetermined pattern, all can be made to be able to turn on, and it can also consider as white flat-surface light. In this case, it is advantageous in respect of the following. That is, when using white LED, it becomes the structure which carries out color conversion of the light from blue LED with a fluorescent substance as that structure, but since the dimension of the white LED of a piece will also contain the part of a fluorescent substance in this case, it becomes large.

[0044] On the other hand, since a dimension can be managed with a luminescence chip size, LED which emits light in red and blue or green primary color can be made [many] compared with the case where the number which the direction which arranges these can arrange to per unit area arranges white LED. Therefore, in the case where arrange and carry out the all-points LGT of the LED which emits light in red, ****, or green primary color, and white is obtained, the white flat-surface light of bigger reinforcement can be obtained. However, if LED which emits light in red and green or blue monochrome is independently used instead of white, the light equipment which is monochrome can be constituted. The light equipment of this monochrome may be used for primary color luminescence of a electrochromatic display.

[0045] In addition, although the resin mold mold LED equipped with convex lens structure at the tip as the point light source was used with the above-mentioned configuration, the LED chip covered neither by LED equipped with a plane resin package nor resin mold may be used. As long as it is the point light source which furthermore emits light with small power, what is depended on other luminescence principles, for example, a semiconductor laser component etc., may be used.

[0046] In the light equipment of the structure of drawing 1 mentioned already, as shown in drawing 2 and drawing 3 , homogeneity is mixed being reflected by the internal surface (reflector 11) within the light guide block 10, and outgoing radiation of the light from LED array 20 is carried out from a field [in which LED array 20 was formed], and opposite **** end-face side.

[0047] In order for the light from LED array 20 to be mixed by homogeneity within the light guide block 10 and to carry out outgoing radiation of the flat-surface light of uniform reinforcement with light equipment here Die-length [of the light guide line of the light guide block 10 shown in drawing 2] L (= L1) and the spacing P between adjoining LED in an LED array Using as theta the include angle from the optical axis of the location where the luminous intensity emitted from each LED becomes half [of the reinforcement on the optical axis of the light from LED], it is set up so that the relation of L>=P/(tantheta) may be filled. Thus, by setting up, the synchrotron orbital radiation from adjoining LED is added, and entropy of intensity distribution is attained. The location where reinforcement is weak may be generated between LED which adjoins that die-length L of a light guide line is P/(tantheta) following, and intensity distribution may not become uniform.

[0048] Moreover, in drawing 2 , a design change is possible for the bore D1 (cross section) and overall length L1 of the light guide line block 10 suitably. The dip and breadth in a bore D1, i.e., a wall, are set up corresponding to the appearance of the liquid crystal display component used combining this light equipment. It constitutes so that it may become the bore which can irradiate light at all the pixels of a liquid crystal display component. LED more than 21 and arrangement are set that incidence is possible in light that LED array 20 does not have a clearance in the bore set as the light guide line block 10, either. The overall length L1 of the light guide line block 10 is set as die length from which light is injected by sufficiently uniform reinforcement in respect of an outgoing end, when the light from the point light source is distributed by reflection by the reflector 11. For example, if size of the bore D1 of the light guide line block 10 is made into the breadth of 24mm, and the dip of 18mm, LED array 20 will be arranged [LED / a total of 48 /21 (diameter of 3mm)] in width 8 train and vertical 6 train. The overall length L1 of the light guide line block 10 is set to about 30mm. What is necessary is to consider as the smaller bore D2 and just to consider as the longer overall length L2, as shown in drawing 3 if the size of a bore D1 is still smaller, and long light guide line length is required in order to obtain the light of uniform reinforcement.

[0049] In the above-mentioned configuration, as shown in drawing 2 , the light injected from LED21 in the part near the center of LED array 20 is injected from the other-end side of a light

guide line, without being reflected in a reflector 11. It is reflected in a reflector 11 and the light injected from LED21 which is in the part near the circumference of LED array 20 on the other hand is injected from an other-end side. Thus, the light injected from each LED21 is mixed within the light guide line block 10. If the optical-axis lay length L1 of this light guide line block 10 is adjusted suitably, the light of uniform reinforcement will be injected from the injection side of the light of the light guide line block 10. The light of this uniform reinforcement is suitable to the incident light to the liquid crystal display component used for a projector or a head mount display.

[0050] Since according to the light equipment of this operation gestalt 1 it is mixed appropriately, reinforcement is equalized and outgoing radiation of the uniform flat-surface light is carried out while the light from LED which is the point light source spreads the inside of a light guide line block as described above, it is suitable as the light source of various liquid crystal displays, such as a projector and a head mount display.

[0051] Moreover, since there are little small, light weight, and power consumption and the point light sources, such as LED, can be driven with a pocket mold power source, such as a cell, it is suitable as lighting for displays of a pocket mold.

[0052] Furthermore, since the light guide line block is equipped with easy structure which stuck the mirror plane, it can be performed easily [manufacture] and cheaply.

(Operation gestalt 2) The operation gestalt 2 of this invention is related with the small projection mold liquid crystal display suitable for using the light equipment explained with the operation gestalt 1. The optical-system block diagram of the projection mold liquid crystal display 300 of this operation gestalt is shown in drawing 4 .

[0053] As the projection mold liquid crystal display 300 is shown in drawing 4 , light equipment 100, the liquid crystal display component 30, the projection lens 31, and the screen 32 are stored in the case 33. Light equipment 100 uses the same thing as the above-mentioned operation gestalt 1. Let the luminescent color of light equipment 100 be white. It is constituted possible that the liquid crystal display component 30 controls transparency of light and nontransparent per pixel according to the driving signal which is not illustrated. That is, the liquid crystal display component 30 carries out incidence of the injection light from light equipment 100, it carries out light modulation according to the logic state of a driving signal, and the output of it is attained as an image. a liquid crystal display component changes the array and sense of a liquid crystal molecule which are arranged regularly with electric field or heat, changes the optical property of a liquid crystal layer, controls transparency/nontransparent of light, and various well-known structures can be boiled and, specifically, it can apply them. Moreover, the liquid crystal display component 30 is equipped with a color filter, and the color pixel consists of two or more pixels corresponding to primary color. And color display has become possible by controlling the existence of transparency of primary lights.

[0054] It is designed possible that the projection lens 31 carries out image formation of the image by which light modulation was carried out with the liquid crystal display component 30 to a screen 32. A screen 32 consists of shape of translucent possible [irregular reflection of light], and is observable [the opposite side of the projection lens 31 to a display image].

[0055] In addition, in applying this invention to liquid crystal displays, such as a head mount display and a view finder, it constitutes so that the image by the liquid crystal display component expanded when the liquid crystal display component is arranged in the location nearer than a before [a projection lens] side focal distance and the projection lens was looked into can be observed.

[0056] Moreover, in applying this invention to the liquid crystal display of the accepting-reality form used for a personal computer or a pocket mold electronic terminal, a projection lens and a screen are excluded, and it constitutes so that a direct liquid crystal display component can be observed.

[0057] According to the above-mentioned configuration, from light equipment 100, the white light of uniform reinforcement is injected and the light modulation which includes color with the liquid crystal display component 30 is received. Although the image which received light modulation can be faced squarely as it is, in order to expand further and to display, it receives refraction

with the projection lens 31. And the enlarged display of the image by which light modulation was carried out with the dilation ratio which becomes settled in the distance of the projection lens 31 and a screen 32 is carried out to a screen 32.
[0058] In addition, in order to enlarge the dilation ratio of a projection image, when the strong quantity of light is required, as shown in drawing 5 , you may make it the configuration of the projection mold liquid crystal display equipped with the liquid crystal display component for every primary color. The projection mold liquid crystal display 400 of drawing 5 is equipped with light equipment 100 and a filter 40 for every primary color, and is further equipped with a dichroic prism 41, the projection lens 42, a screen 43, and a case 44. A filter 40 (R, G, B) changes the white light from light equipment 100 into the light of each primary color. The filter 40 (R, G, B) may be arranged between light equipment 100 and the liquid crystal display component 30. In addition, the filter 40 is unnecessary if LED21 which specifies the luminescent color of light equipment 100 is constituted from a component which emits light with each primary color. The amount of luminescence also with the high twist which combines LED and the filter of white luminescence is expectable. A dichroic prism 41 is equipped with multilayers 41R which can reflect only red, and multilayers 41B which can reflect a blue chisel, compounds the image by which light modulation was carried out for every primary color, and is constituted possible [injection] towards the projection lens 42. About a projection lens and a screen, it is the same as that of the operation gestalt 1. In this projection mold liquid crystal display, it is expectable that a bright image is obtained.
(Modification) this invention can be changed and applied to versatility, without being restrained by the above-mentioned operation gestalt For example, in light equipment, a light guide line block may be constituted in the shape of [of other configurations and the triangle pole which were set by the appearance of the viewing area of not only the shape of the square pole which described the cross-section configuration above but a liquid crystal display component, a pentagonal prism, and others] a polygon. Furthermore a wall consists of curved surfaces and you may constitute in the shape of [which a cross section presents a circle and an ellipse] a cylindrical shape. Moreover, hollow structure which constitutes a light guide line is made into the cavity, and also it may be filled up with a transparent material.
[0059] As a point light source array, as described above, the point light sources other than LED can be used. Moreover, an array configuration may be made not only into two-dimensional arrangement of the above-mentioned whole surface but into two-step structure, and may be constituted that injection light from a lower layer cannot be easily covered by the upper LED. The configuration of a point light source array seems namely, for what is necessary to be just to become a plane with the projection configuration of a point light source array almost equal to the end face of a light guide block which attends this.
(Operation gestalt 3) According to drawing 6 and drawing 7 , the gestalt 3 of operation concerning this invention is explained.
[0060] the light emitting diode (LED) 103 which counters the end side (incidence end face) of the transparent material 102 which is the square bar of acrylic resin, and serves as the point light source with another object in a transparent material 102 -- the shape of a field -- it is specifically arranged on two-dimensional. Another end face (outgoing radiation end face) of a transparent material 102 is countered, and the liquid crystal display component 101 is arranged. The liquid crystal display component 101 is irradiated with the light which carried out outgoing radiation from the outgoing radiation end face of a transparent material 102. The image displayed on the liquid crystal display component 101 is expanded with the projection lens 104, and is projected on a screen 105.
[0061] The magnitude of the viewing area of the liquid crystal display component 101 is 10.2mmx7.6mm (it is 0.5 inches at a vertical angle), and is a component in which the color display equipped with the color filter for every pixel is possible.
[0062] The magnitude of the end face which counters the liquid crystal display component 101 and LED103 which the transparent material 102 went up and down is 12mmx8mm, and die length is 50mm. Although magnitude 10.2mmx7.6mm of the liquid crystal display voxel child's 101 viewing area of the dimension of the end face of a transparent material is sufficient, it is

enlarged a little from the viewing area with this operation gestalt. Moreover, although the light which spreads the inside of a transparent material repeats total reflection on the side face of a transparent material 102, in order to control loss of the light by dispersion, this side face is a mirror plane or a total reflection side.
[0063] As the quality of the material of a transparent material 102, transparence resin other than an acrylic or glass can be used.
[0064] The color of the synchrotron orbital radiation of LED103 is white. LED103 has the structure where the light emitting device is covered by resin, and the lens configuration is formed at the tip. The diameter of LED103 is 3mm, the incidence end face of a transparent material 102 is countered, and six LED is arranged as a two-dimensional array of 3x2.
[0065] It mixes, while spreading a transparent material 102, and entropy of the intensity distribution is carried out and the light emitted from each LED illuminates uniformly the viewing area of the liquid crystal display component 101. It is necessary to optimize the die length of a transparent material 102 depending on the directivity of the synchrotron orbital radiation by the magnitude of a display valley, the number of LED103 and spacing of an array, or the lens configuration at a tip.
[0066] In order to mix light to homogeneity within a transparent material 102 and to carry out outgoing radiation of the flat-surface light of uniform intensity distribution preferably, it is set up so that die-length [of a light guide line] L and spacing P between adjoining LED103 may be made into the include angle theta from the optical axis of the location where the luminous intensity emitted from each LED becomes half [of the intensity distribution on the optical axis of the light from LED] and the relation of L>=P/(tantheta) may be filled with a transparent material 102. Thus, by setting up, the synchrotron orbital radiation from adjoining LED is added, and entropy of intensity distribution is attained. The location where reinforcement is weak may be generated between LED which adjoins that die-length L of a light guide line is P/(tantheta) following, and nonuniformity may arise in intensity distribution.
[0067] In addition, the array of LED1033 is preferably prepared [transparent material / 102] through an air space in this transparent material 102 with another object. In this structure, within a transparent material, light carries out total reflection with the flank wall concerned, light is mixed and intensity distribution carry out entropy of the flank walls other than the optical outgoing radiation side of a transparent material by processing polish etc. Moreover, it may be the transparent material 102 of a solid, or reflective film, such as a metal thin film, may be prepared in a flank end face.
[0068] The projection lens 104 consists of two or more lenses, for example, a diameter is 30mm. A viewing area expands the image of the liquid crystal display component 101 which is 0.5 inches of vertical angles to 7 inches of vertical angles, and projects it on a screen 105.
[0069] When displaying a video image and a television picture on the liquid crystal display component 101, it can display on the display circuit (not shown) connected to a liquid crystal display component with about [5V] direct current voltage using a circuit [****]. Moreover, since LED103 emits light with about [3V] direct current voltage, a cell can be used as a power source of the liquid crystal display component of the gestalt (operation gestalt 3) of this operation. therefore, compared with the conventional projection mold liquid crystal display using the metal halide lamp etc. as the light source, the whole equipment is boiled markedly and it can miniaturize.
[0070] although the gestalt (operation gestalt 3) of this operation explained the configuration of the display which illuminates the liquid crystal display which used the color filter in white LED, it is green and the image of monochrome, for example, LED which emits light, and the monochrome come out of and illuminated is mixed for the liquid crystal display component which excluded the color filter -- or time sharing -- a stroke -- it is also possible to constitute the equipment which projects on a field and obtains a color picture.
[0071] Moreover, although light used LED of structure which has a lens configuration for the part which carries out outgoing radiation as LED103, it is also possible to use LED whose part light carries out [a part] outgoing radiation is the Taira end face. In this case, in order to make uniform distribution of the transverse-plane light in a liquid crystal display component, it is

necessary to optimize the die length of a transparent material 102.
[0072] Moreover, although LED explained the arranged light source with the light equipment in the gestalt (gestalt 3 of operation) of this operation, the configuration which leads the synchrotron orbital radiation of LED to a liquid crystal display component can also be considered, bringing radiation luminous-intensity distribution close uniformly by the transparent material, even when one LED is made into the light source.
[0073] Moreover, if the supporter material for carrying out support immobilization of the transparent material 102 at a liquid crystal display contacts the side face of a transparent material 102, it sets into the part, and light will be scattered about or absorbed and the quantity of light which reaches to a liquid crystal display component will fall. Therefore, it is effective in order that returning light into a transparent material by vapor-depositing a metal thin film on the transparent material front face of a part on which supporter material contacts, or pasting up a mirror plane-like reflexibility member on it may not reduce the use effectiveness of light.
(Operation gestalt 4) The operation gestalt 4 concerning this invention is explained below. In addition, with this operation gestalt 4, about the same part as the configuration of said operation gestalt 3, the same part number is attached and explanation of that configuration is omitted.
[0074] As shown in drawing 8 and drawing 9 , LED103B to which the description of the operation gestalt 4 emits light in blue as light emitting diode (LED) 103 is applied.
[0075] In this LED103B, as is shown in drawing 10 , the field array is carried out two-dimensional in three-line six trains on a substrate 109, for example, between 2.5mm and a train has become [spacing] 2mm: In addition, this array is not limited.
[0076] Moreover, the fluorescence film 107 is arranged at the outgoing radiation side side of a transparent material 102. Color conversion of this fluorescence film 107 is excited and carried out with a blue light, and the white lights including the blue glow which a red fluorescent substance and a green fluorescent substance are used as a fluorescent substance, and passes this fluorescence film 107 are generated with the gestalt (operation gestalt 4) of this operation.
[0077] To such light equipment, the liquid crystal display component 101, the projection lens 104, and a screen 105 can be arranged to the downstream of said fluorescence film 107, and a liquid crystal display can be constituted.
[0078] In this case, it is advantageous in respect of the following. That is, when using white LED, it becomes the structure which carries out color conversion of the light from blue LED by the transparent material as that structure, but since the dimension of the white LED of a piece will also contain the part of a transparent material in this case, it becomes large. On the other hand, since a dimension can be managed with a luminescence chip size, the direction which arranges these can make [many] LED which emits light in blue compared with the case where white LED is arranged for the number which can be arranged to per unit area. Therefore, only a blue LED array can be arranged and used and it can obtain that the white light [perform / strengthen radiation luminous energy and / color conversion] is stronger.
[0079] (Operation gestalt 5) The operation gestalt 5 concerning this invention is explained below. In addition, with this operation gestalt 5, about the same part as the configuration of said operation gestalt 3, the same part number is attached and explanation of that configuration is omitted.
[0080] As shown in drawing 11 and drawing 12 , the description of the operation gestalt 5 is in the point that LED 103R, 103G, and 103B colored in each color of RGB was applied as light emitting diode (LED) 103.
[0081] In this LED 103R, 103G, and 103B, as is shown in drawing 13 , the field array is carried out two-dimensional in three-line six trains on a substrate 109, and between 2.5mm and a train has become [spacing] 2mm. Moreover, each color is arranged alternately. In addition, this array is not limited.
[0082] In addition, with the gestalt (operation gestalt 5) of this operation, although LED corresponding to three primary colors is used, as long as there is no trouble in generation of a color picture, LED which emits light by the sour orange instead of red, and emits light by colors, such as yellowish green, to instead of [green] may be used.
[0083] Since the color filter is attached in each pixel of a liquid crystal display component with

this operation gestalt 5, the white light is desirable as the self-luminous color. Therefore, it is common to turn on all LED103 on the above-mentioned substrate 109 to coincidence, it is passing a transparent material 102, and thereby, each color can be intermingled and the white light can be acquired.
[0084] With this operation gestalt, in LED to which a dimension emits light in red smaller than white LEDD and blue or green primary color as mentioned above, it specifically arranges two-dimensional, and the shape of a field, and in order to make light emit, the consistency of the light source becomes large and the flat-surface light of bigger reinforcement is obtained.
[0085] In addition, said LED 103R, 103G, and 103B is separated, and it may be made to carry out sequential lighting for a short time extremely for every color. This is the method to which the after-image of human being's eyes is used for, and the interlace of a television picture was applied. Unit power consumption can be lessened and the part, a cell, etc. can be made to withstand long use by carrying out sequential lighting.
(Modification) The modification of the color picture display which used sequential lighting is shown in drawing 14 .
[0086] A color filter does not exist in each pixel of the liquid crystal display component 101 applied to this modification. Synchronizing with sequential lighting of LED 103R, 103G, and 103B, the image for every color is formed and a color picture is displayed.
[0087] Namely, a picture signal is inputted into the color separation circuit 210, and is separated for every chrominance signal. Each chrominance signal by which color separation was carried out by this color separation signal is supplied to a synchronous circuit 212 and the LCD driver 214. The LCD dry cleaning 214 controls the liquid.crystal display component 101 based on the inputted chrominance signal, and forms an image.
[0088] On the other hand, in a synchronous circuit 212, the chrominance signal and synchronization corresponding to the image displayed by the LCD driver 214 are taken, and a multiplexer 216 is supplied. In a multiplexer 216, sequential selection of the R driver 218, the G driver 220, and the B driver 222 is made, and a lighting signal is supplied, respectively. Thereby, the color which suits to the liquid crystal display component 101 is turned on. In addition, as for the image displayed on a screen 105, the image with which three colors were mixed according to the after-image effectiveness is displayed like the above-mentioned.
[0089] According to the above-mentioned configuration, since the image of each color can be expressed using all the pixels of the liquid crystal display component 101, resolution of an image can be made into 3 times compared with the liquid crystal display component of a color filter method.
[0090]
[Effect of the Invention] Since it had the structure of the light guide line which can lead light without optical loss to an irradiated field, for example, the display area of a liquid crystal display component, using point light source lighting, such as light emitting diode, two or more according to this invention, the light source and the projection mold liquid crystal display which can display small and the projection image which is lightweight and cheap and moreover does not have unevenness in luminous intensity can be offered.
[0091] Moreover, it has the effectiveness which can constitute the small light equipment which is made to carry out entropy of the intensity distribution, for example, can illuminate a liquid crystal display uniformly by making a light guide means spread the light emitted from two or more light emitting devices arranged two-dimensional in addition to the above-mentioned effectiveness.
[0092] Furthermore, when LED is used as a light emitting device in addition to the above-mentioned effectiveness, luminescence by the cell is possible and it can miniaturize further.
[0093]

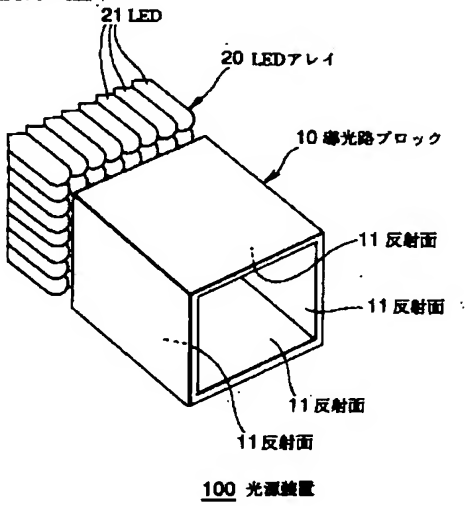
[Translation done.]

* NOTICES *

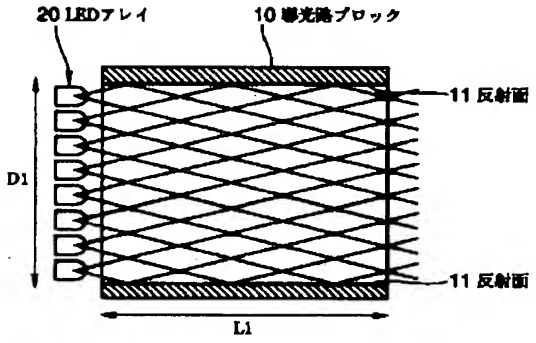
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

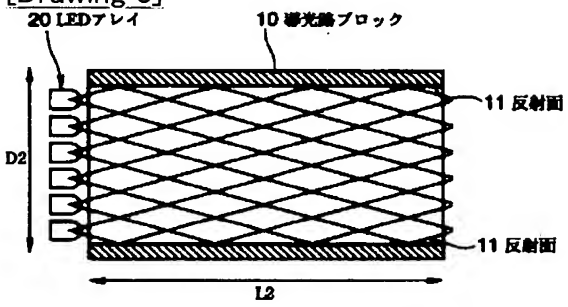
[Drawing 1]



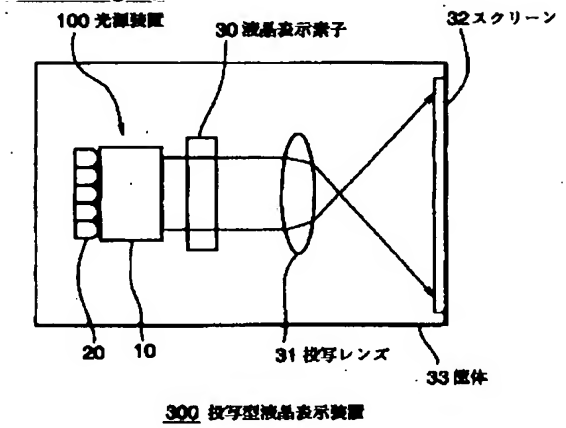
[Drawing 2]



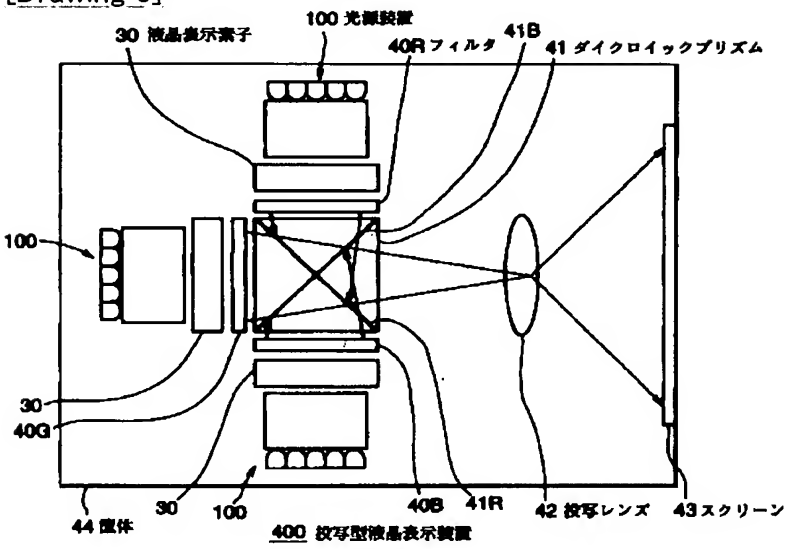
[Drawing 3]



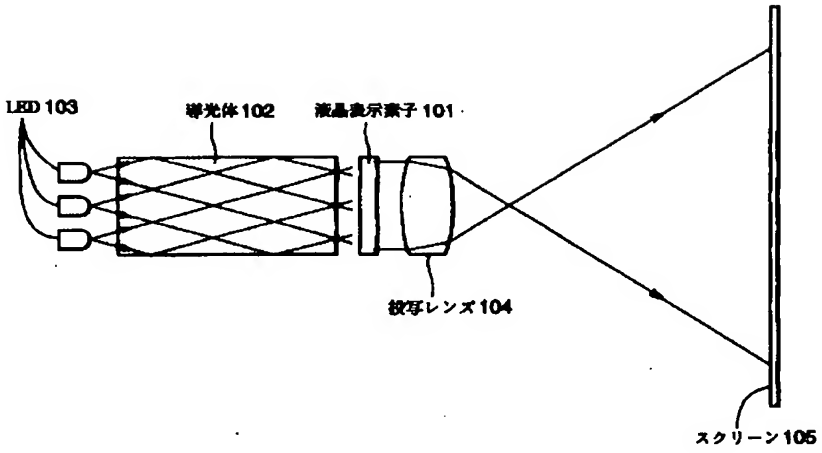
[Drawing 4]



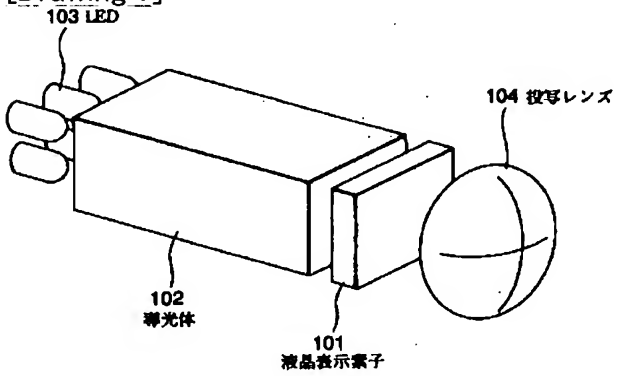
[Drawing 5]



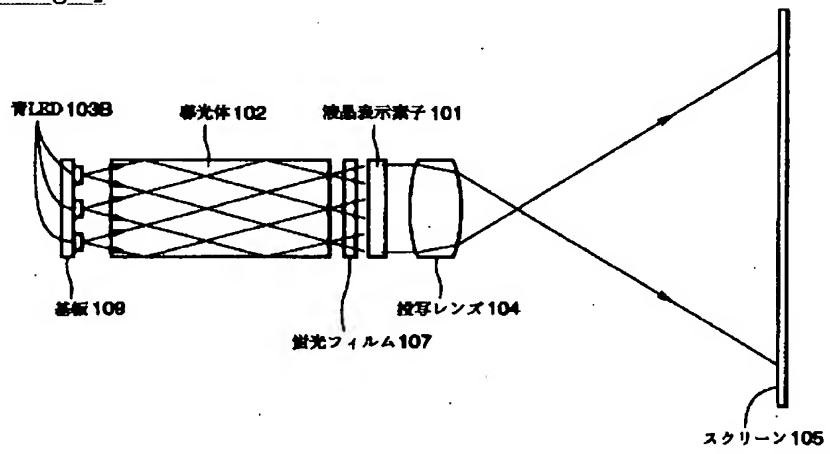
[Drawing 6]



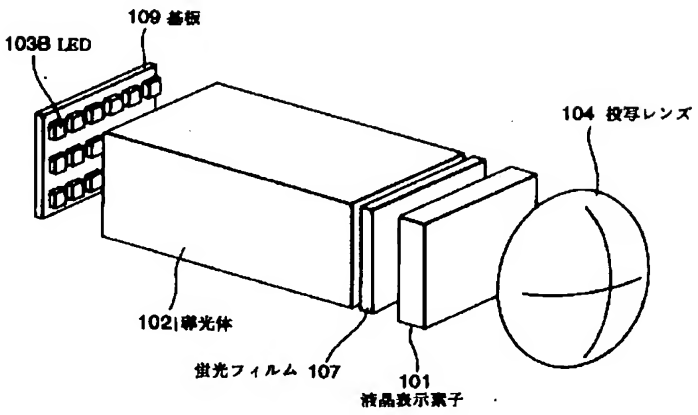
[Drawing 7]



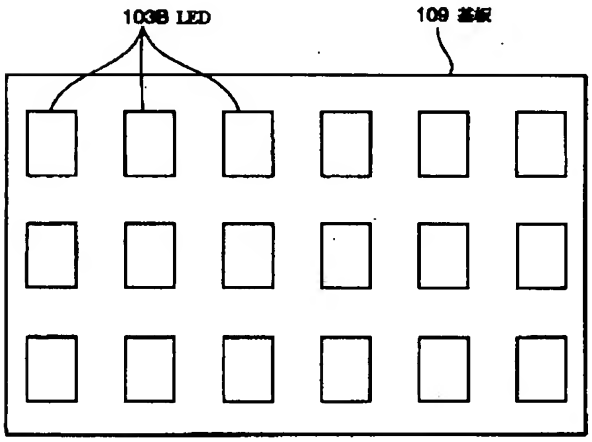
[Drawing 8]



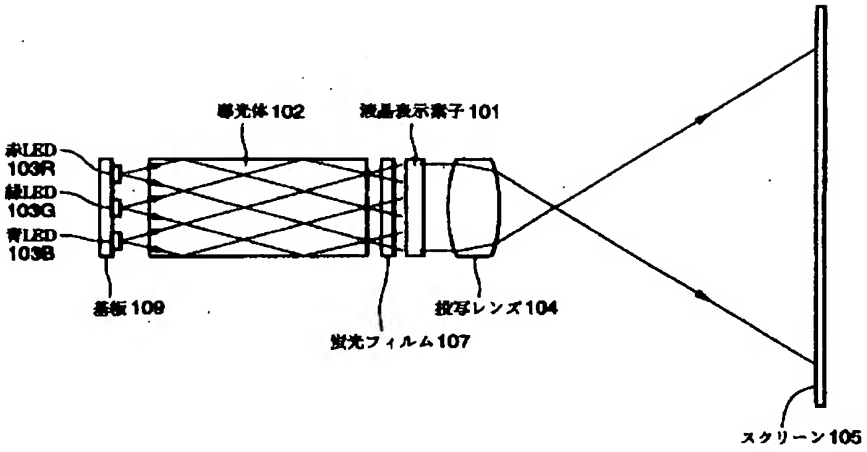
[Drawing 9]



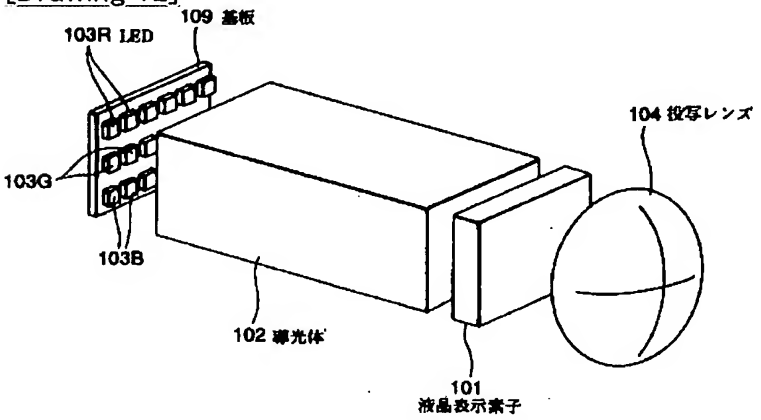
[Drawing 10]



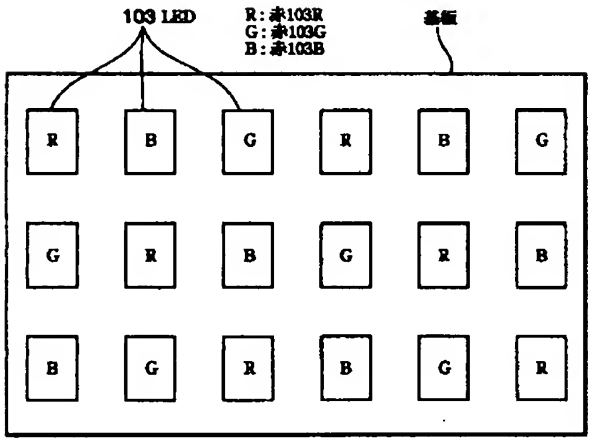
[Drawing 11]



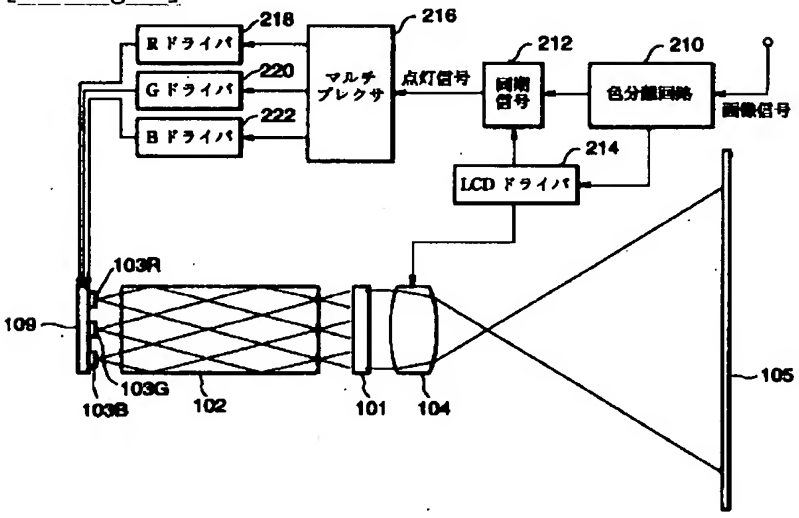
[Drawing 12]



[Drawing 13]



[Drawing 14]



[Translation done.]